Dalhousie University
Faculty of Engineering
Department of Mechanical Engineering

Biomechanical Arm Assist

Ben Galbraith
William Parsons
Arvin Rahimzadeh
Shaymus Veinotte

Introduction

- Client was born with Duchenne Muscular Dystrophy (DMD)
- DMD is a genetic disorder characterized by progressive muscle degradation
- The client has trouble lifting objects and has limited range of motion
- They are looking for a device to help them become more independent with everyday activities, such as eating food, drinking, etc.
- **SOLUTION**: A mechanical device that increases the client's strength and mobility in their dominant (right) arm, increasing independence

Requirements

1) Device shall allow the client to lift a 0.25 kg, 8" long dinner fork from their lap to their mouth with only device assistance
2) User shall be in full control of the motion, direction, and speed of the device assistance while in use
3) Device shall not cause muscle strain, skin irritation, or pinching within 18 hours of continuous use
4) Device shall not prevent wheelchair from passing through a 30" wide doorframe
5) Device shall not impact wheelchairs current form, fit, or function

Details of Final Design

- Adjustable spring loaded torsion joint for assisted elbow flexion
- Adjustable linear spring and pulley actuation for assisted shoulder flexion
- Custom thermo-forming splinting arm supports
- Lightweight aluminum chassis and carbon steel supports

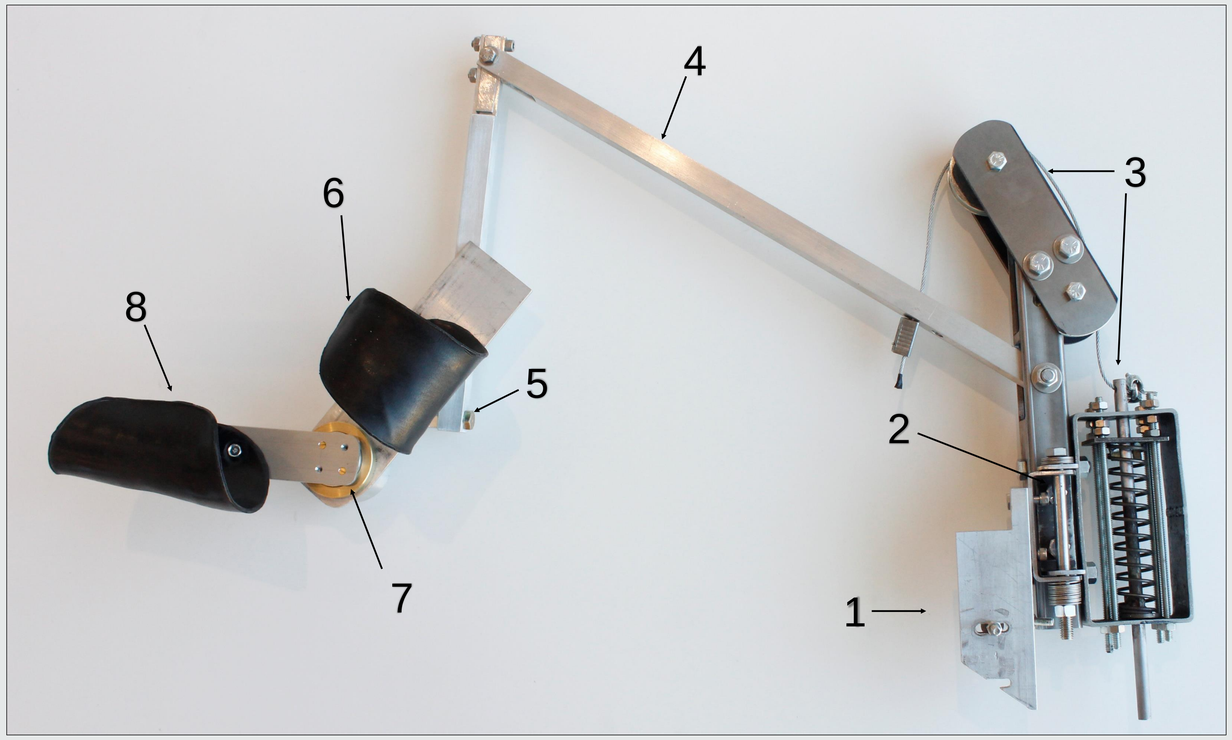

Figure 1 Device installation on wheelchair

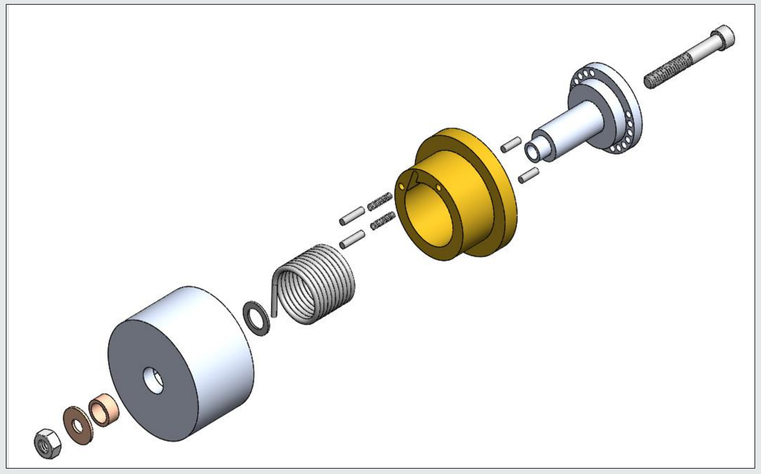

Figure 2 Exploded view of spring loaded elbow joint

Main Components

1) Device mount for wheelchair application
2) Hinge joint for device transverse motion
3) Linear spring adjustor and pulley assembly
4) Aluminum linkages for assisted shoulder flexion
5) Ball joint attachment for elbow assembly
6) Upper arm splint
7) Spring loaded Elbow joint (See Figure 2)
8) Forearm splint

Project Status

Completed:

- The device has been integrated onto the wheelchair
- The device has been fit for the client using the splinting material
- The client's range of motion with the device has been tested
  - No restrictions on range of motion were found

Future Plan:

- The device's assistance level is currently being tuned for the client for optimal range of motion
  - Eating and drinking tests will be performed to validate device function
- Continuous use tests will be performed to determine if any causes of irritation or strain are present
- A docking system will be designed for easy storage of the device when it's not in use

All images were either taken or produced by the design team from Sept 2018 to April 2019
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